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(56) Für die Beurteilung der Patentfähigkeit in Betracht gezogene Druckschriften:

DE-AS 11 03 961
US 28 847

(54) Brillenartige Vorrichtung zur Einblendung von Zusatzinformationen in den Sichtbereich

(57) Eine optische Vorrichtung in Form einer Brille oder dgl. für in den normalen Sichtbereich einzufügende zusätzliche Informationen in Form von Meßwerten, Texten, bildlichen Darstellungen und sonstigen Daten umfaßt eine in diese integrierte visuelle Signalquelle (4) und ein letzterer zugeordnetes asphärisches Ablenkprisma (5) sowie eine auf mindestens einem Brillenglas (8) oder Schutzglasfläche gebildete Reflexionsfläche (6). Die Signalquelle (4) ist an eine in die Brille integrierte Sensorik (1) oder an eine externe Informationseinheit angeschlossen. Die Anzeigevorrichtung ist einfach zu handhaben und zur Einblendung unterschiedlichster Informationen geeignet.

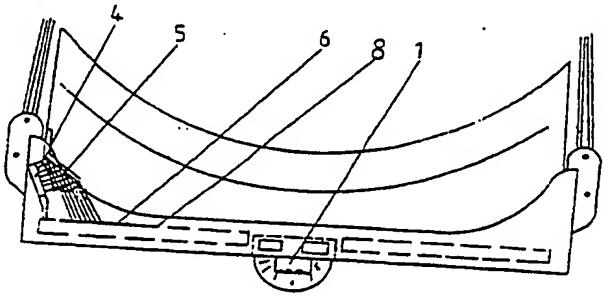

Fig. 3 eine vergrößerte Darstellung des in der Anzeigevorrichtung verwendeten asphärischen Ablenkprismas mit dem entsprechenden Strahlenverlauf zwischen der Anzeige und der Reflexionsfläche; und

Fig. 4 eine Ansicht einer Ausführungsvariante der erfindungsgemäßen Vorrichtung mit einem in das Brillengestell integrierten Mini-Bildschirm, der mit einer von der Brille getrennt angeordneten Kamera, einem Personalcomputer oder dgl. verbunden wird.

Fig. 5 eine Draufsicht nach Fig. 4.

In der Zeichnung ist mit 7 das Gestell und mit 8 das Brillenglas einer Brille, die in Fig. 1 eine Taucherbrille ist, aber auch, wie in Fig. 4, eine beliebige andere, als Sehhilfe oder zum Schutz der Augen verwendete Brille sein kann. Gleichermaßen kann die "Brille" nur mit Normalglas versehen sein und — als Haltevorrichtung und Reflexionsfläche — lediglich zur Darstellung der von ihrem Träger benötigten Informationen in dessen Sichtbereich dienen.

Gemäß Fig. 1 und 2 ist am Gestell 7 einer Taucherbrille eine Druckdose 1 als die einzublendenden Meßwerte lieferndes Meßgerät angebracht. Im Gestell 7 der Taucherbrille ist weiterhin ein Gehäuse 2 zur Unterbringung einer Spannungsquelle und eines Schaltkreises, die mit der Druckdose 1 verbunden sind, vorgesehen. An die Druckdose 1 ist das Display 4 eines LED-Elements angeschlossen, mit dem die Meßwerte der Druckdose 1 in Form von Lumineszenzstrahlen wiedergegeben werden. Am Gestell 7 der Taucherbrille ist weiterhin ein im Strahlengang 9 des Displays 4 liegendes Ablenkprisma 5 mit asphärisch wirkenden brechenden Flächen an der Ein- und Austrittsseite der Lichtstrahlen angeordnet. Das Ablenkprisma 5 lenkt die von dem LED-Element ausgesendeten Strahlen auf eine auf der Innenseite des Brillenglases 8 vorgesehene, teilweise durchlässige Reflexionsfläche 6, an der ein Teil der vom Ablenkprisma 5 abgelenkten Strahlen reflektiert wird und auf das menschliche Auge 10 trifft. Im Sichtbereich des Trägers der Brille liegt somit sowohl die durch die Brillengläser 8 und durch deren natürliche oder bewußt aufgebrachte teilweise Verspiegelung (Reflexionsfläche 6) hindurch sichtbare Szene als auch die von der Reflexionsfläche 6 zum Auge reflektierte Zusatzinformation des Displays 4 des LED-Elements.

Entsprechend der Ausbildung des Ablenkprismas 5 und dessen Abstand zum Display 4 erscheint die zusätzliche visuelle Information in einer Entfernung von einigen Metern vom Auge des Tauchers. Gleichermaßen ist jedoch in Abhängigkeit von der Gestaltung der Flächen 5a und 5c des Ablenkprismas 5 eine Abbildung der vom Display ausgestrahlten Zusatzinformationen im Unendlichen möglich. Neben der hier beispielhaft angegebenen Druckmessung können auch andere für das Tauchen wichtige Daten gemessen und über die LED-Anzeige, das Ablenkprisma 5 und die Reflexionsfläche 6 am Brillenglas 8 für das Auge sichtbar abgebildet werden.

Die genaue Ausbildung des Ablenkprismas 5 mit einem Teil des Strahlengangs 9 der vom Display 4 ausgesendeten Lichtstrahlen ist in Fig. 3 wiedergegeben. Das Ablenkprisma 5 ist an der dem Display 4 zugewandten Eintrittsfläche 5a asphärisch konkav gewölbt, so daß alle Bereiche des Displays 4 gleichmäßig erfaßt werden und eine scharfe Wiedergabe der visuellen Signale des Displays 4 möglich ist. Die über die asphärisch konkav gewölbte Eintrittsfläche 5a in das Ablenkprisma 5 eintretenden divergent verlaufenden Strahlen werden an der gegenüberliegenden ebenen Ablenkfläche 5b reflektiert und in Richtung der asphärisch konvex gewölbten Austrittsfläche 5c des Ablenkprismas abgelenkt. An der asphärisch konvex gewölbten Austrittsfläche 5c werden die divergenten Strahlen so gebrochen, daß sie parallel zueinander verlaufen, um die von der teilweise durchlässigen Reflexionsfläche 6 auf das Auge zurückgeworfenen Strahlen im Unendlichen als zusätzliche Information abzubilden. Um die Zusatzinformation in geringerer Entfernung vom Auge 10, zum Beispiel in einigen Metern, darzustellen, ist die Austrittsfläche derart konvex gewölbt, daß die austretenden Strahlen konvergieren.

Die Durchlässigkeit der Reflexionsfläche 6 richtet sich nach der Helligkeit des Displays, d. h. je größer die Lichtstärke der LED-Anzeige ist, umso größer kann die Durchlässigkeit der Verspiegelung sein, um dennoch durch diese hindurchsehen zu können und gleichzeitig die zusätzliche Bildinformation deutlich erkennbar zu machen. Zur Einstellung der Kontraststärke der in das Blickfeld eingefügten Zusatzinformation ist die Lichtstärke des Displays regulierbar.

Wie aus der Zeichnung erkennbar ist, nimmt die Reflexionsfläche 6 nur einen kleinen Teil der Fläche des Brillenglases 8 ein, so daß das Gesichtsfeld bzw. die Beobachtung der Szene im wesentlichen nicht eingeschränkt wird. Andererseits kann bei ausreichender Durchlässigkeit der Reflexionsfläche 6 auch ein größerer Teil des Brillenglases 8 oder gar dessen gesamte Fläche teildurchlässig verspiegelt sein bzw. können die natürlichen Reflexionseigenschaften von Brillengläsern genutzt werden.

Das Ablenkprisma ist einstückig ausgebildet und besteht aus Kunststoff. Es kann jedoch auch mehrteilig, nämlich aus einem Prisma und mit diesem fest verbundener asphärisch plankonkaver und asphärisch plankonvexer Linse, ausgebildet sein und entsprechend der Ausführung des Displays, der Lichtstärke, der Farbe und dgl. aus einem anderen geeigneten Werkstoff bestehen.

Die Art der Anzeige der Daten ist selbstverständlich nicht auf ein Display auf der Basis von Lumineszenzdioden beschränkt. Sie kann beispielsweise gleichermaßen über eine LCD-Anzeige oder auch, wie anhand des nachfolgenden Beispiels gezeigt wird, mit einem Mini-Bildschirm, hier mit CCD-Bildschirm, erfolgen.

Die Fig. 4 und 5 zeigen eine Ausführungsvariante der Erfindung, bei der am Gestell 7 einer Brille ein CCD-Bildschirm 11 angebracht ist. Die Einblendung der vom CCD-Bildschirm 11 abgegebenen Information in das Gesichtsfeld des Trägers der Brille erfolgt auf die gleiche Weise wie am Beispiel der in den Fig. 1 bis 3 beschriebenen Taucherbrille, das heißt, über das Ablenkprisma 5 mit den konkav bzw. konvex asphärisch wirkenden, brechenden Ein- und Austrittsflächen 5a, 5c und der dazwischen liegenden Ablenkfläche 5b sowie die teildurchlässige Reflexionsfläche 6 am Brillenglas 8. Die Erzeugung der Bildinformation erfolgt hier nach der Erfindung über eine auf das die Bildinformation abgebende Mittel gerichtete CCD-Kamera (nicht dargestellt), die mit dem CCD-Bildschirm 11 über eine Verbindungsleitung 12 verbunden ist. Das Objekt, auf das die CCD-Kamera gerichtet ist, kann beliebiger Art sein. Unter Verzicht auf die CCD-Kamera kann der CCD-Bildschirm 11 auch direkt an ein die einzublendenden Daten lieferndes Gerät, beispielsweise einen PC-Monitor o. ä., angeschlossen sein. Auf diese Weise ist es möglich, auf die Reflexionsfläche 6 des Brillenglases 8 die von einem Computer abgegebenen Informationen zu projizieren und wie oben beschrieben in das Gesichtsfeld eines Benutzers einzublenden. Die CCD-Kamera

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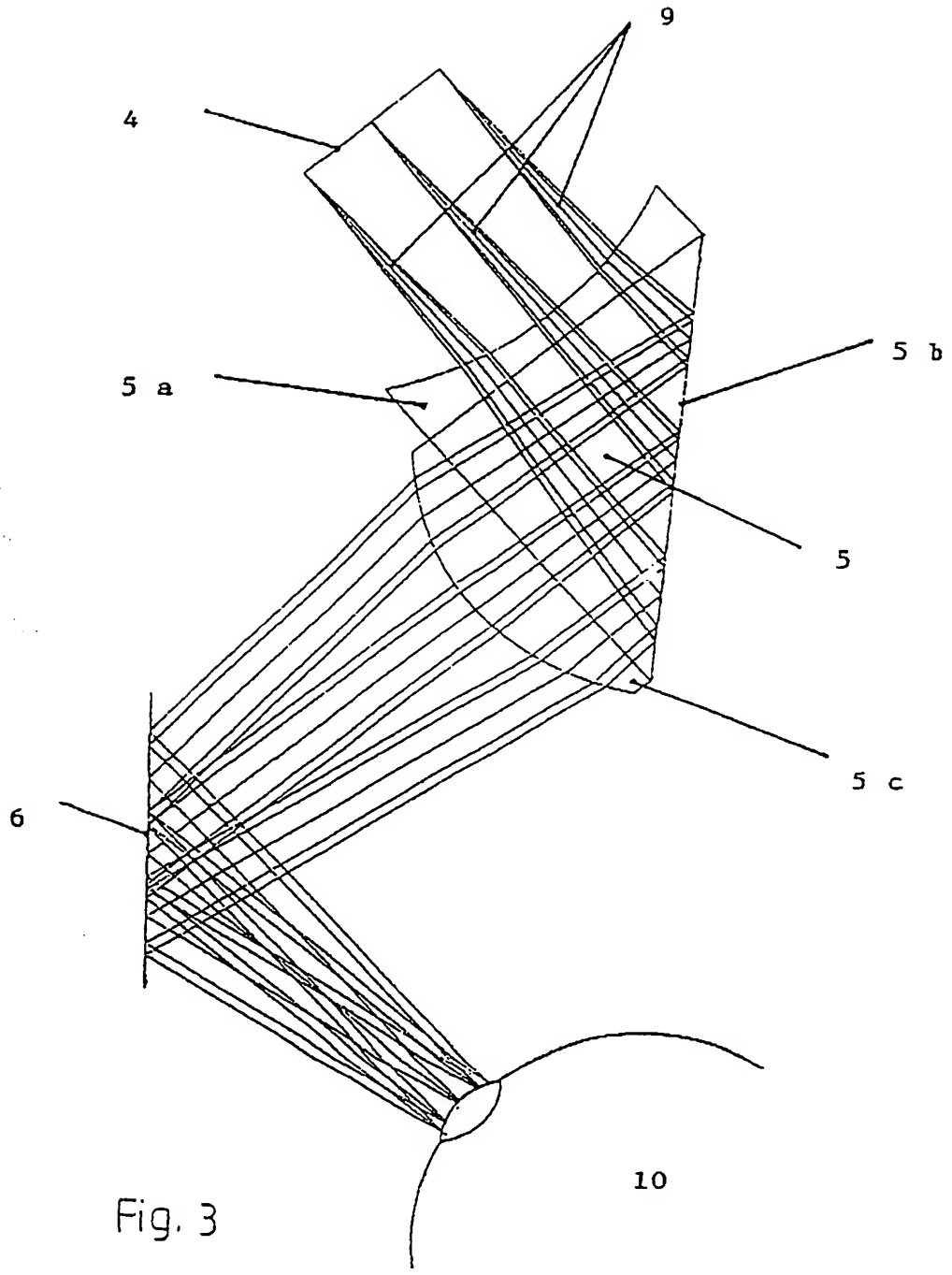

Fig. 3

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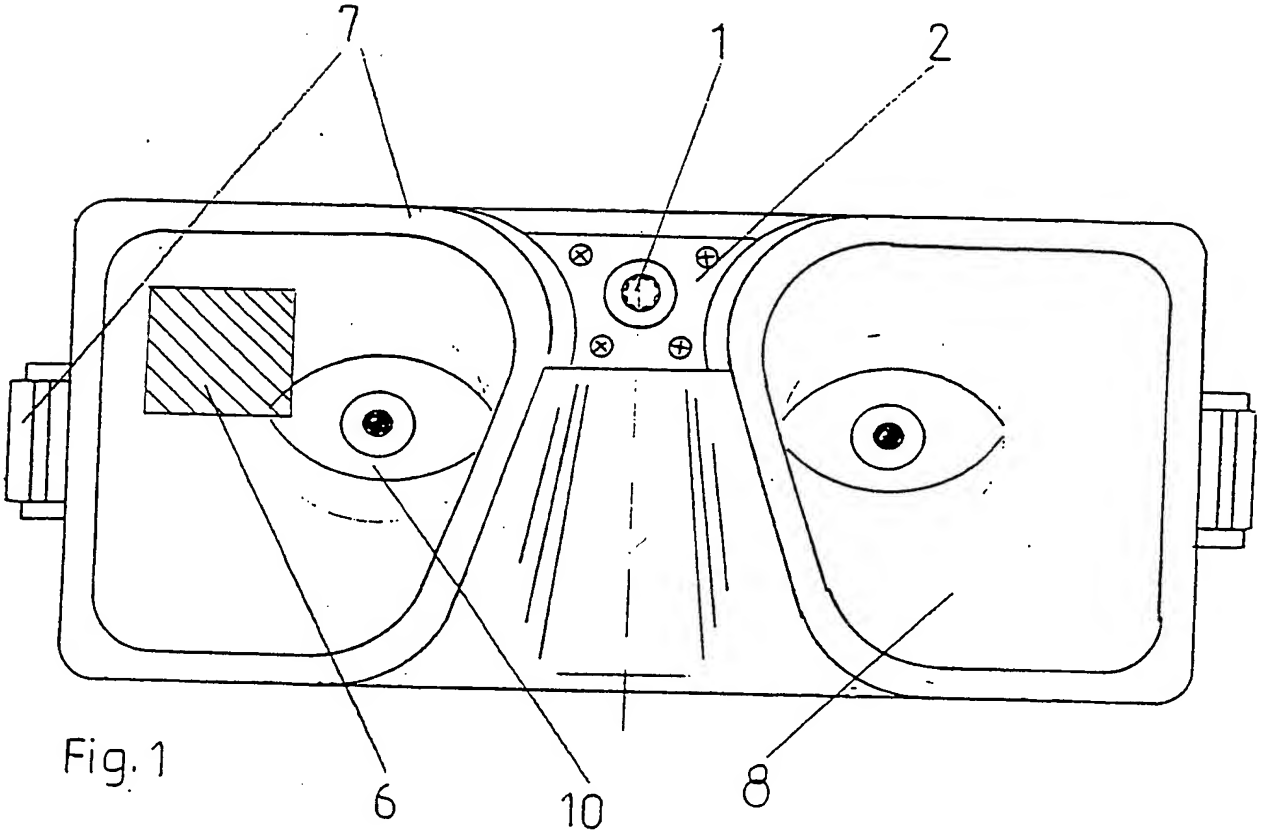

Fig. 1

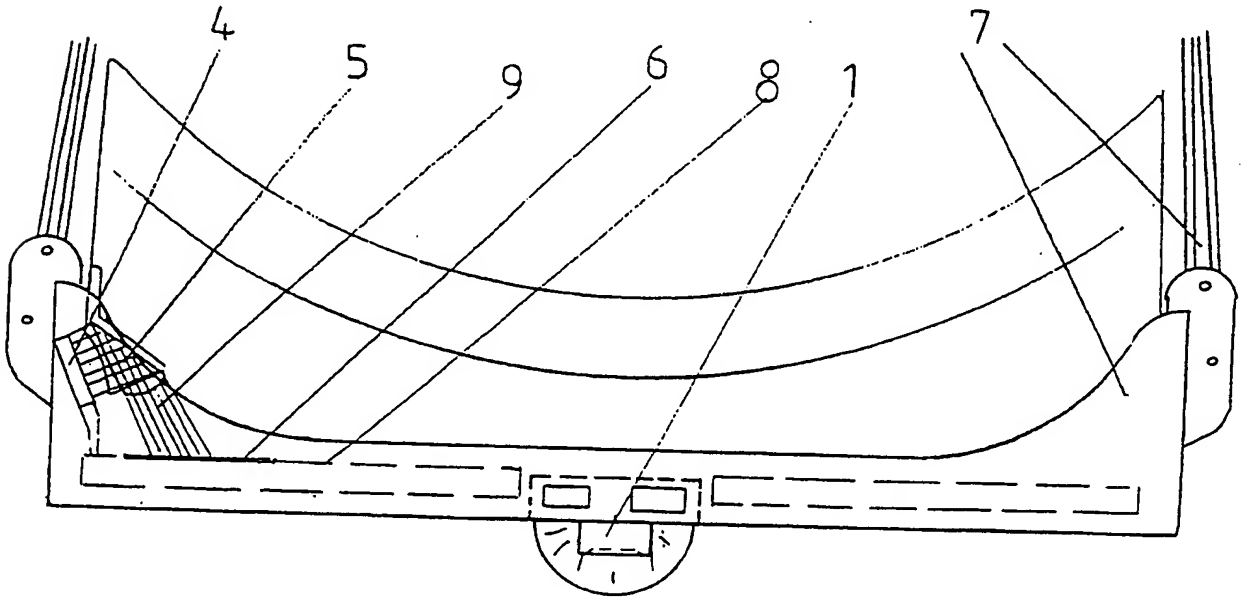

Fig. 2

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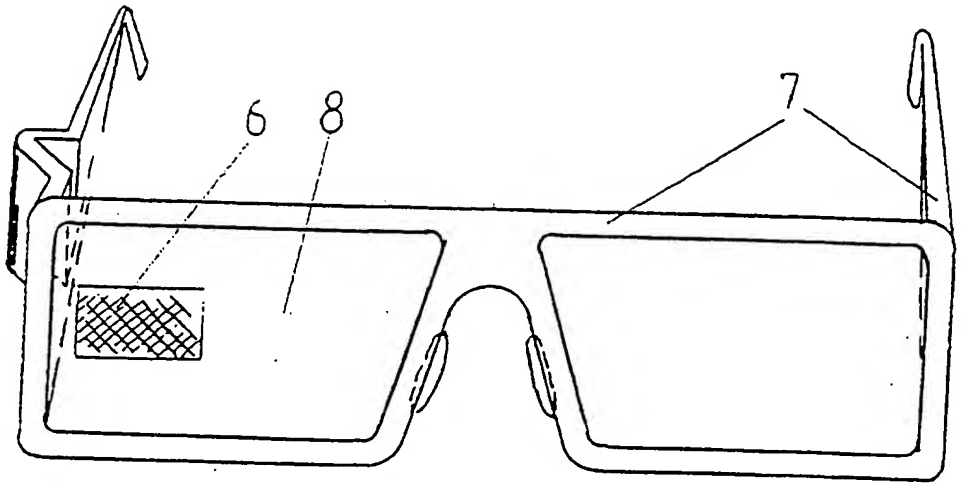

Fig. 4

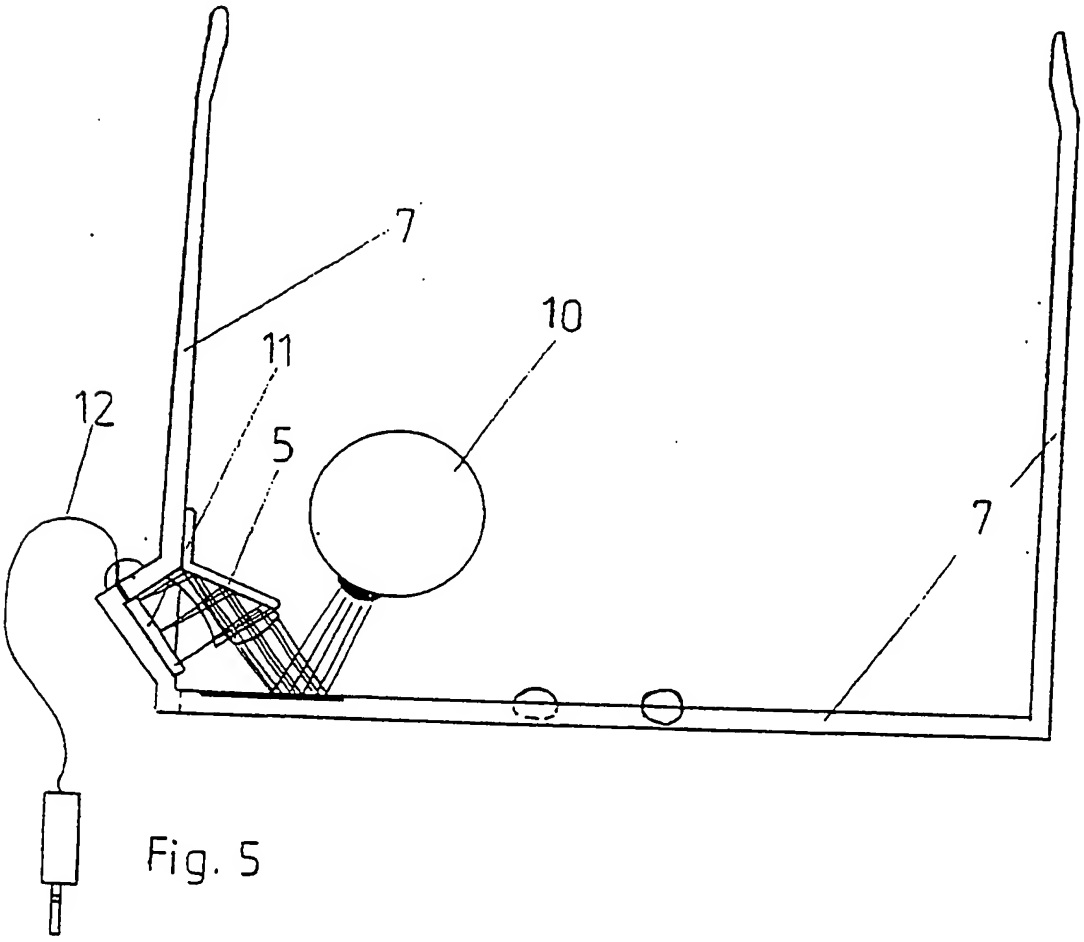

Fig. 5

SPECTACLE-LIKE DEVICE FOR BLENDING ADDITIONAL INFORMATION INTO MAIN FIELD OF VIEW

The present invention relates to a spectacle-like device for projecting additional information into the field of view of a person, using a signal source radiating visual information and an optical system projecting this information into the field of view.

US 37 87 109 already describes a display device attached to a helmet, in which an inner reflecting surface of a partially transparent screen arranged on the helmet in front of the eyes of the user has a curve for aligning the light beams originating from a light source generating an image. The curve creates a definable focal point, in with the light of the light source and thus the image to be displayed appears visible to the eye. This display system is attached to the mounting on a helmet, restricting its applications.

In addition, DE-PS 11 03 961 discloses an image reproduction device in spectacle form for displaying a television image, in which an electron radiation tube is attached to the spectacle bow in an axis running parallel to the latter, whereof the monitor points in the direction of view of the user. In order to deflect the image generated on the monitor to the eye, a deflection system composed of mirrors or a prism located in front of the eye is situated in a housing on the spectacle bridge. The deflection system is however expensive and difficult to construct, and is limited in its application. It is particularly advantageous that with this image reproduction device connected to spectacles the field of view of the user is substantially restricted.

The object of the invention is therefore to develop a spectacle-like device for projecting additional information into the field of view of a person, which can be used in

multiple applications and is easy to handle, and does not limit or only marginally limits the normal field of view of the user.

According to the present invention the problem is solved using a spectacle-like optical device for projecting additional information, which comprises a signal source for radiating visual signals and an optical system for projecting these signals into the field of view of a user, such that the optical system comprises a partially transparent reflecting surface formed by or on a spectacle or protective glass surface, and a deflecting prism with aspherically acting refractive entry surface and output surface and a plane deflection surface, located in the radiation path of the signal source connected to the spectacle-like device.

Otherwise expressed, the method of the invention lies in the combination of conventional spectacles, which are fitted with normal glass or which serve in the usual manner as a visual aid or protective spectacles, and which on the side of the glass facing the eye have a partially transparent reflecting surface, with a display connected to the spectacles, sending out visual signals and an aspherical deflecting prism arranged between the latter and the reflecting surface of the glass.

Due to the entry surface aspherically concave according to a further characteristic of the invention and facing the display the edge regions of the display are acquired so as to be able to generate an image of uniform sharpness. The divergent beams are reflected on the deflection surface of the deflecting prism in the direction of the output surface, aspherically convex according to the present invention, and there they are bundled into beams directed parallel or converging further, on the reflecting surface, in order to project the information displayed on the display into the normal field of view of the user infinitely or at a short

distance, for example a few meters. The projected additional information can be uniformly well recognised in every position adopted by the user. On the other hand, the optical system comprising deflecting prism and reflecting surface and the display are of such a light weight that the whole device is easy to handle are no more inconvenient for the user to wear than a pair of normal spectacles. Furthermore the minimal weight and the minimal space requirement enable being combined with spectacles.

Countless applications are possible using the device proposed according to the present invention for adding additional information into the field of view. By connecting the display to various measuring instruments, which are integrated into the frame of the spectacles or are arranged separately therefrom via a suitable connection, for example using diving goggles, the diving depth, the tank pressure, the dive time or the decompression time can be displayed in the normal field of view of a diver, or in the case of mountain climbers with sunglasses the height, the air temperature and the like can be projected into the field of view. A further application option involves the medical field with the ongoing observation of parameters of the human body, or when driving vehicles, piloting aircraft and ships for - independent of the position of the user - information on various data constantly in the field of view.

In an advantageous embodiment of the invention a display based on light-emitting diodes or liquid crystals is provided as display, which is connected directly to the spectacles with a voltage source, a switching circuit and a device supplying the desired data. The devices upstream of the inventive device, and supplying the data to be displayed can also be housed in a carry box for example in an arrangement separate from the spectacles. The connection to the display can be made via a connecting wire or can be wireless.

According to another characteristic of the invention the display attached to the spectacles is designed as monitor, which is connected either directly to specific visual information carriers, supplying the information to be displayed in the field of view, such as fax machines, PC monitors or the like, or is connected to a camera generating the visual information, aimed at objects in the environment.

Further characteristics and advantageous configurations of the invention are detailed in the independent claims.

The invention will now be explained in greater detail by means of embodiments with reference to the diagram, in which:

Figure 1 is a view of diving goggles fitted with an inventive device for displaying additional information in the field of view of a diver;

Figure 2 is a plan view according to Figure 1;

Figure 3 is an enlarged illustration of the aspherical deflecting prism used in the display device with the corresponding radiation trajectory between the display and the reflecting surface; and

Figure 4 is a view of a variant embodiment of the inventive device with a mini screen integrated into the spectacles frame, which is connected to a camera arranged separately from the spectacles, a personal computer or the like.

Figure 5 is a plan view according to Figure 4.

In the diagram the frame is designated by 7 and the spectacle lens of spectacles by 8, which in Figure 1 are diving goggles, but also, as in Figure 4, can be any other spectacles used as visual aid or for protecting the eyes. In

the same way the "glasses" can be provided with normal glass only and - as holding device and reflecting surface - serve only to display the information required by their wearer in his field of view.

In accordance with Figures 1 and 2 a barometric cell 1 is attached to the frame 7 of the diving goggles as a measuring instrument delivering the measured variables to be projected. Provided in the frame 7 of the diving goggles also is a housing 2 for accommodating a voltage source and a switching circuit, which are connected to the barometric cell 1. Attached to the barometric cell 1 is the display 4 of an LED element, with which the measured variables of the barometric cell 1 are reproduced in the form of luminescent beams. Arranged on the frame 7 of the diving goggles is a deflecting prism 5, lying in the radiation path 9 of the display 4, and with aspherically working refractive surfaces on the inlet and outlet side of the light beams. The deflecting prism 5 deflects the beams sent out from the LED element onto a partially transparent reflecting surface 6 provided on the inside of the spectacle lens 8, on which a portion of the beams deflected by the deflecting prism 5 is reflected, and reaches the human eye 10. Lying in the field of view of the wearer of the spectacles is both the scene visible through the spectacle lens 8 and through its natural or applied partial reflective coating (reflecting surface 6), and the additional information of the display 4 of the LED element reflected from the reflecting surface 6 to the eye.

According to the design of the deflecting prism 5 and its distance from the display 4 the additional visual information appears at a distance of a few meters from the eye of the diver. Similarly, displaying the additional information radiated by the display is possible, however, depending on the shape of the surfaces 5a and 5c of the deflecting prism 5. Apart from the pressure measurement, given here by way of example, other data important for diving can also be measured

and displayed visibly via the LED display, the deflecting prism 5 and the reflecting surface 6 on the spectacle lens 8 for the eye.

The exact design of the deflecting prism 5 with a portion of the beam path 9 of the light beams sent out by the display 4 is reproduced in Figure 3. The deflecting prism 5 is aspherically concave on the entry surface 5a facing the display 4, so that all areas of the display 4 are captured uniformly and a sharp reproduction of the visual signals of the display 4 is possible. The beams running divergently over the aspherically concave entry surface 5a entering the deflecting prism 5 are reflected on the opposite flat deflection surface 5b and are deflected in the direction of the aspherically convex output surface 5c of the deflecting prism. On the aspherically convex output surface 5c the divergent beams are broken up such that they run parallel to one another, to infinitely display the beams thrown back by the partially transparent reflecting surface 6 onto the eye as additional information. In order to display the additional information at a shorter distance from the eye 10, for example a few meters, the output surface is curved convexly such that the exiting beams converge.

The transparency of the reflecting surface 6 matches the brightness of the display, i.e. the greater the light strength of the LED display, the greater the transparency of the reflective coating can be, to be able to see through the latter and at the same time to make the additional visual information clearly recognisable. The light intensity of the display can be regulated to adjust the contrast strength of the additional information added into the field of view.

As is evident from the diagram, the reflecting surface 6 takes in only a small portion of the surface of the spectacle lens 8, so that the field of view or the observation of the scene is essentially not limited. On the other hand in the

case of adequate transparency of the reflecting surface 6 a greater portion of the spectacle lens 8 or even its whole surface can be reflected translucently, or the natural reflective properties of spectacle lens can be utilised.

The deflecting prism is designed monobloc and comprises a plastic material. However, it can also be designed multipart, namely from a prism and an aspherically plano-concave and aspherically plano-convex lens attached to the latter, and according to the design of the display, the light intensity, the colour and the like may comprise any other suitable material.

The type of display for data is of course not limited to display based on light-emitting diodes. The data can be displayed for example via a LCD display or also, as shown by the following example, with a mini screen, here with CCD display screen.

Figures 4 and 5 illustrate a variant embodiment of the invention, in which a CCD display screen 11 is attached to the frame 7 of spectacles. The information put out by the CCD display screen 11 into the field of view of the wearer of the spectacles is projected in the same way as in the example of the diving goggles described in Figures 1 to 3, that is, via the deflecting prism 5 with the concave or convex aspherically working, refractive input and output surfaces 5a, 5c and the intermediate deflection surface 5b, as well as the partly transparent reflecting surface 6 on the spectacle lens 8. The visual information is generated here according to the present invention via a CCD camera (not shown) aimed at the means outputting the visual information, which is connected to the CCD display screen 11 via a connecting line 12. The object, at which the CCD camera is aimed, can be any kind. In the absence of the CCD camera the CCD display screen 11 can also be connected directly to a device supplying the data to be projected, for example a PC Monitor or similar. In this way it

is possible project the information onto the reflecting surface 6 of the spectacle lens 8 put out by a computer and, as described above, into the field of view of a user. The CCD camera including voltage source, PC terminal and PC monitor can be housed in a carry box and can be connected via the connection line 12 to the CCD display screen 11 faxed to the frame 7 of the spectacles.

According to the diagram the visual information is projected only onto a single spectacle lens 8 with the corresponding reflecting surface 6. However, it is also possible to provide two cameras and to assign a mini screen, a deflecting prism and a reflecting surface to both spectacle lenses in each case, to thus achieve a stereo effect.

The invention is naturally not limited to the abovementioned embodiments only, that is, generating the visual information for reproduction on a display device integrated into the spectacle frame, and also the display itself, can also be carried out by other systems not described in the embodiment. By way of example, video or fibre optics cables can also be provided for transmitting the visual information.

Claims:

1. A spectacle-like device for projecting additional information into the field of view, using a visual information radiating signal source and an optical system projecting this information into the field of view, characterised in that the optical system (5, 6) comprises a partially transparent reflecting surface (6) formed by or on a spectacle or protective glass surface (8), and a deflecting prism (5) located in the beam path (9) of the signal source (4, 11) connected to the spectacle-like device, with aspherically working refractive entry surface (5a) and output surface (5c) as well as a plane deflection surface (5b).

2. The device as claimed in Claim 1, characterised in that the entry surface (5a) of the deflecting prism (5) facing the signal source (4, 11) is aspherically concave and its output surface (5c) directed at the partially transparent reflecting surface (6) is aspherically convex.

3. A display device as claimed in Claim 1 and 2, characterised in that the deflecting prism (5) is composed of a plano-concave aspherical lens, a prism and a plano-convex aspherical lens.

4. The device as claimed in any one of Claims 1 to 3, characterised in that the deflecting prism (5) is designed monobloc.

5. The device as claimed in any one of Claims 1 to 4, characterised in that the reflecting surface (6) is formed by the natural reflection of the inside of the spectacle lens (8) directed at the eye.

6. The device as claimed in any one of Claims 1 to 5, characterised in that the reflecting surface (6) comprises a

reflective layer applied to at least a partial area of the surface of the spectacle lens (8) facing the eye.

7. The device as claimed in any one of Claims 1 to 6, characterised in that the signal source is a light-emitting element, which is connected to a device supplying the additional information to be projected.

8. The device as claimed in Claim 1 to 7, characterised in that the device for supplying the additional information is a measuring instrument, which is integrated into the frame (7) of the spectacles, or is arranged separately and is connected to the signal source via a connecting line (12) or wireless.

9. The device as claimed in Claim 8, characterised in that the signal source is a display (4), preferably adjustable in its light intensity, based on a light-emitting diode or liquid-crystal display.

10. The device as claimed in any one of Claims 1 to 7, characterised in that the signal source is a mini screen and the device for delivering the additional information is a camera aimed at specific objects, connected to the mini-monitor by way of a connecting line (12), or the mini-monitor is connected directly to a visual information transmitter.

11. The device as claimed in any one of Claims 1 to 7 and 10, characterised in that to achieve a stereo effect both spectacle lenses (8) are in each case assigned a mini screen, an aspherical deflecting prism and a reflecting surface and each mini screen is assigned a camera or another visual information transmitter.

12. The device as claimed in Claim 10 and 11, characterised in that data is transferred to the mini screen via fibre optics.

13. The device as claimed in any one of Claims 1 to 7, characterised in that the signal source is a mini PC monitor connected to a separately arranged personal computer.

Abstract

An optical device in the form of spectacles or the like for additional information to be added to the normal viewing area, in the form of measured variables, text, images and various data, comprises a signal source (4) integrated into the latter and an aspherical deflection prism (5) assigned to the latter, as well as a reflective surface (6) formed on at least one spectacle lens (8) or protective glass surface. The signal source (4) is connected to a sensor (1) integrated into the spectacles or to an external information unit. The display device is easy to handle and is suited to project a wide range of information.